Stochastic cooling and 56 MHz SRF update for Run-14

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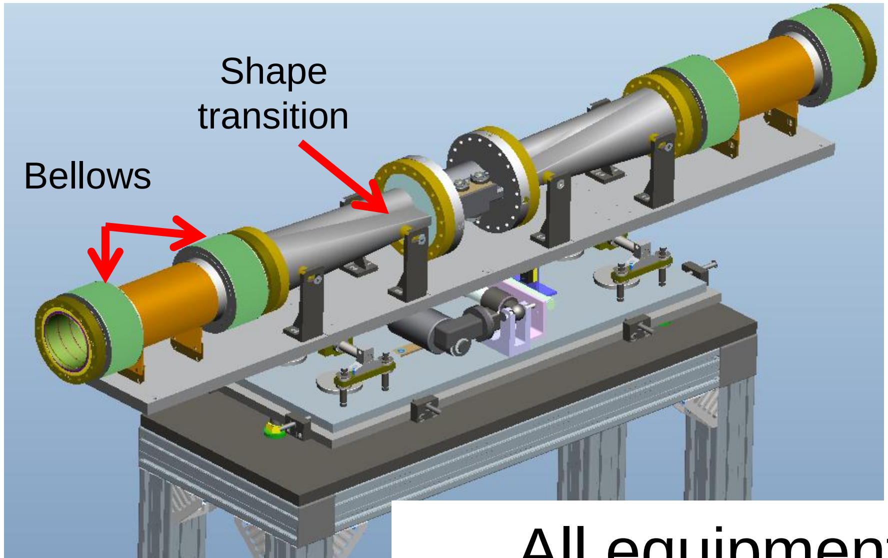
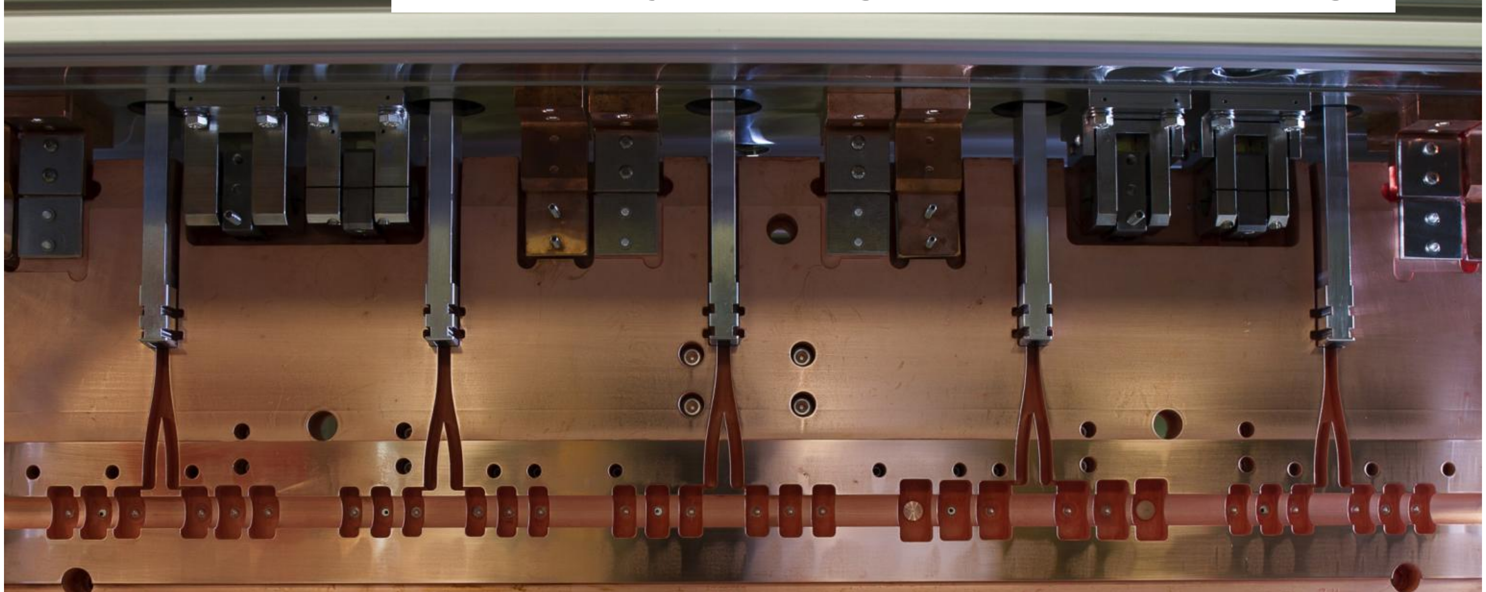
21 January 2014

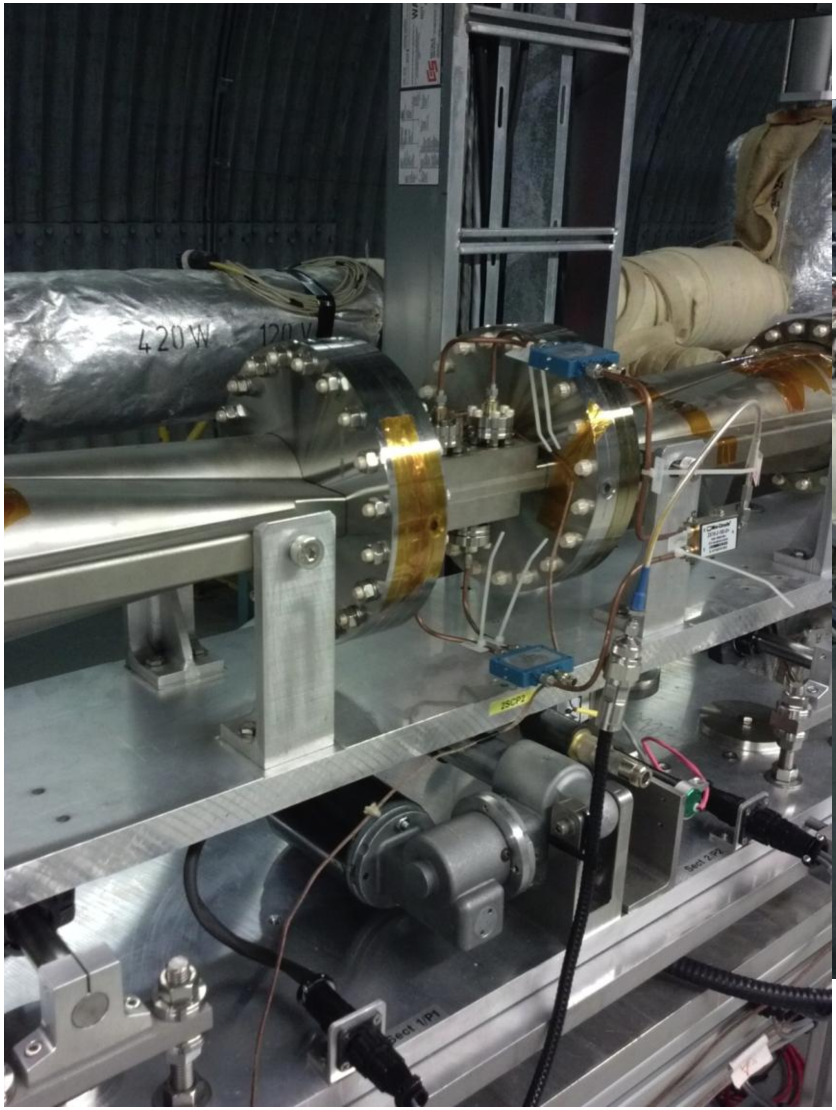
New longitudinal stochastic cooling equipment – M. Brennan et al.



All equipment in the tunnel currently baking, and connecting

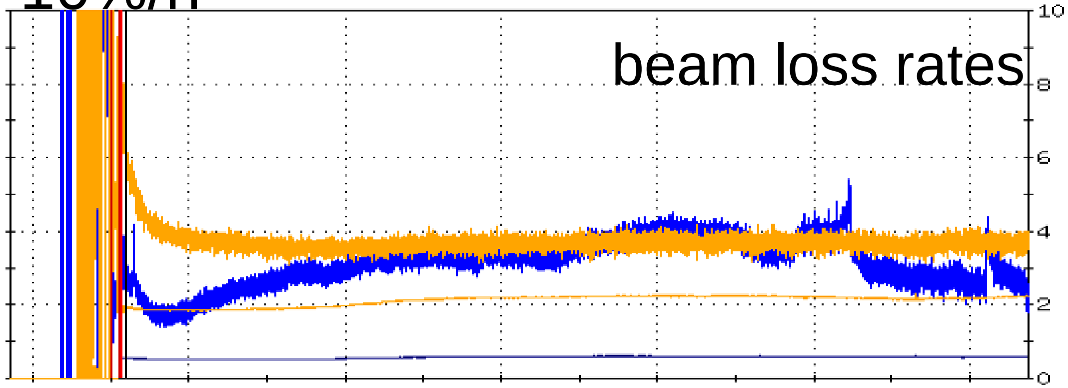


New longitudinal stochastic pickup and kicker



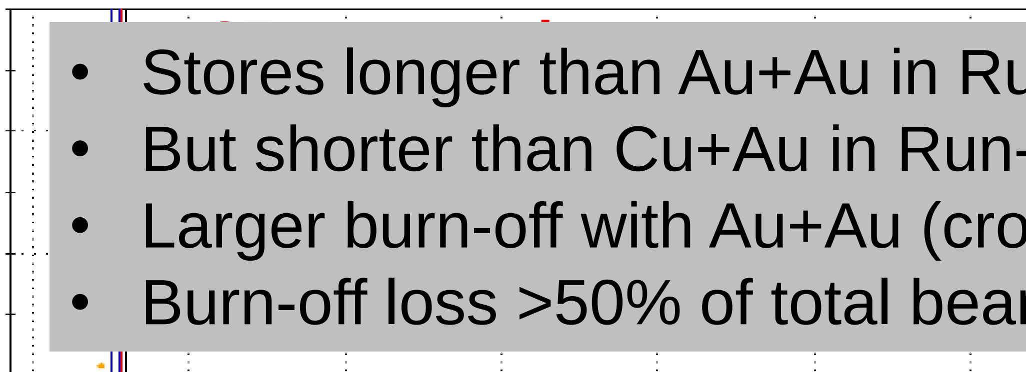
Cu+Au store – new mode in 2012

10%/h



Cu and Au have different

- intrabeam scattering growth rates ($\sim Z^4 N_b / A^2$) $r_{\mathrm{IBS,Au}} \approx 2\mathrm{x}\ r_{\mathrm{IBS,Cu}}$
- cooling rates ($\sim 1/N_b$) $r_{\mathrm{SC,Au}} \approx 3\mathrm{x}\ r_{\mathrm{SC,Cu}}$

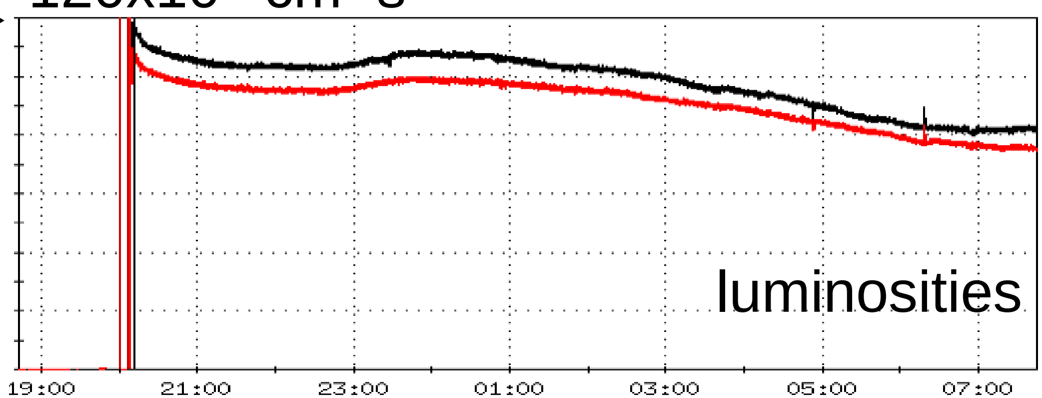


- Stores longer than Au+Au in Run-11 (~4h)
- But shorter than Cu+Au in Run-12 (~14h)
- Larger burn-off with Au+Au (cross sections ~7x larger)
- Burn-off loss >50% of total beam loss

stochastic cooling

- Increase bunch intensity until loss at transition (previously: until ε increase)
- Larger ε before transition?

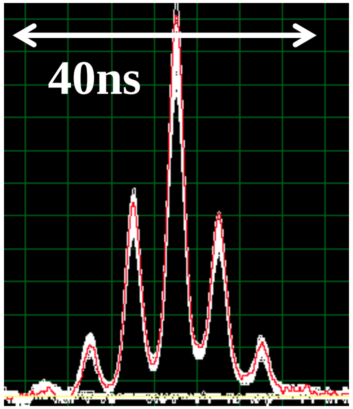
120x10^{26}cm^{-2}s^{-1}



56 MHz SRF

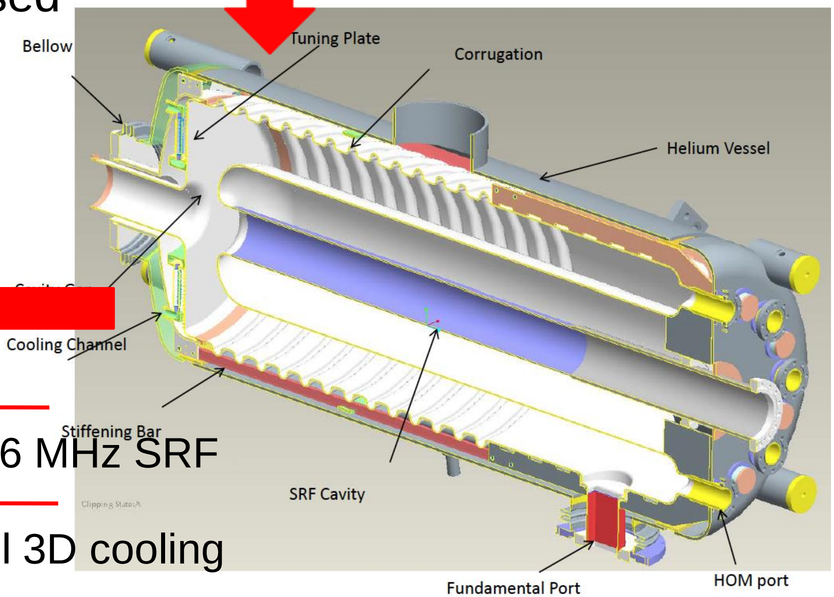
- First superconducting RF system in RHIC
- Provides more longitudinal focusing (against IBS)
  30-50% more luminosity in small vertex
- Cavity delivered to tunnel last Friday (18 January 2014)
- Currently being connected
- Commissioning in Run-14,
  possibly performance impact at end of run

Ongoing: **56 MHz SRF, more long. focusing** (AIP FY08-11, $4M)

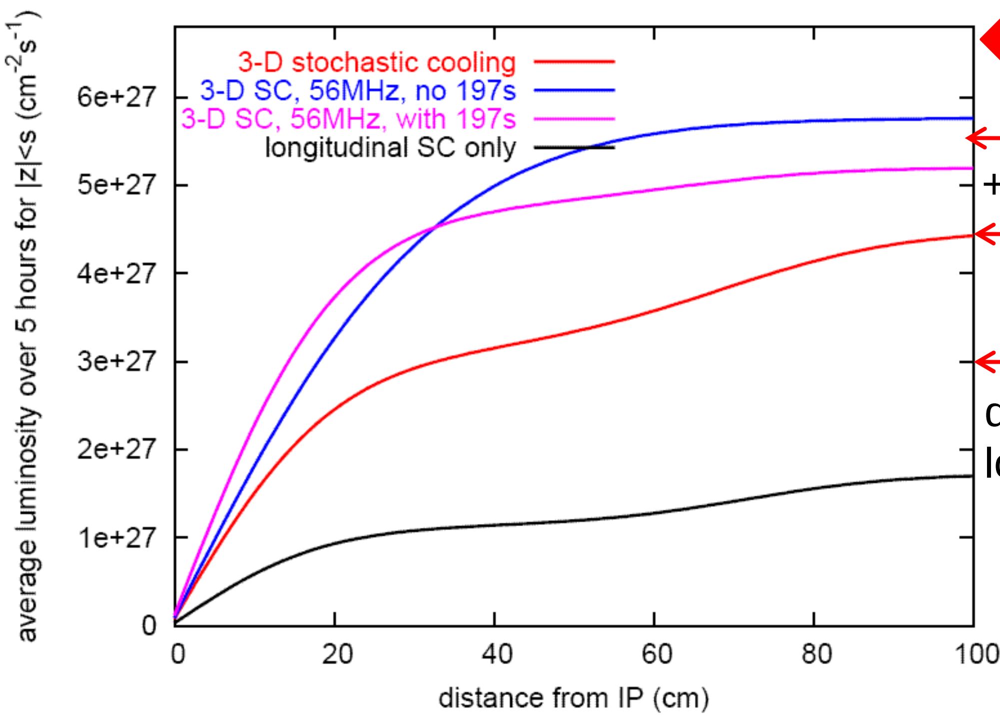


Longitudinal profile at end of store

- even with cooling ions migrate into neighboring buckets
- can be reduced with increased longitudinal focusing



Average luminosity vs. vertex size



+ 56 MHz SRF

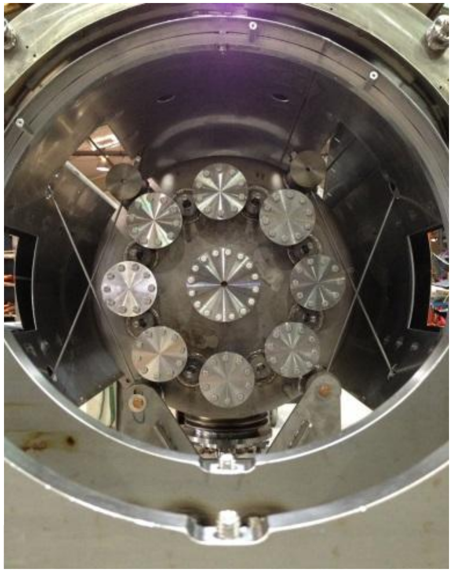
full 3D cooling

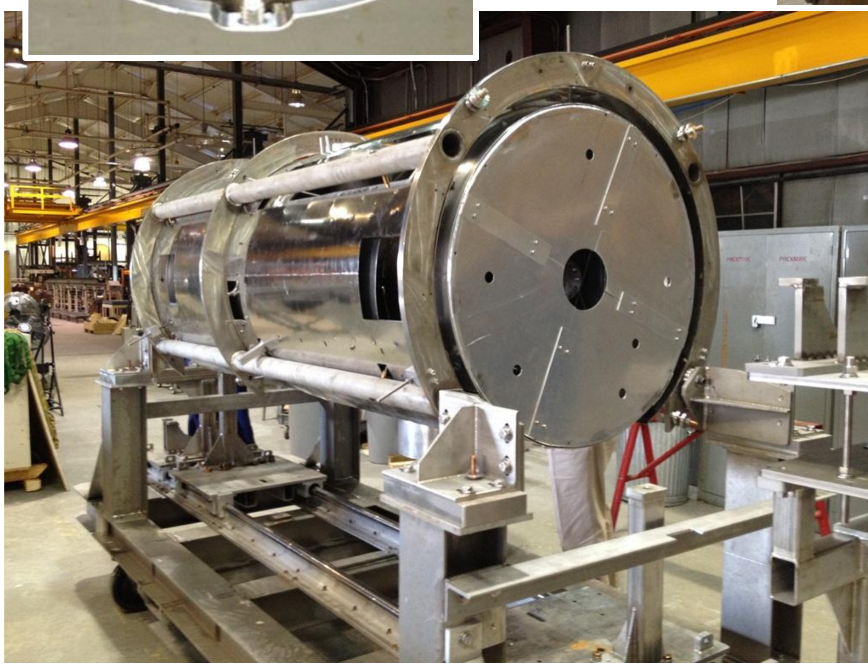
demonstrated 2011
long. + ver. cooling

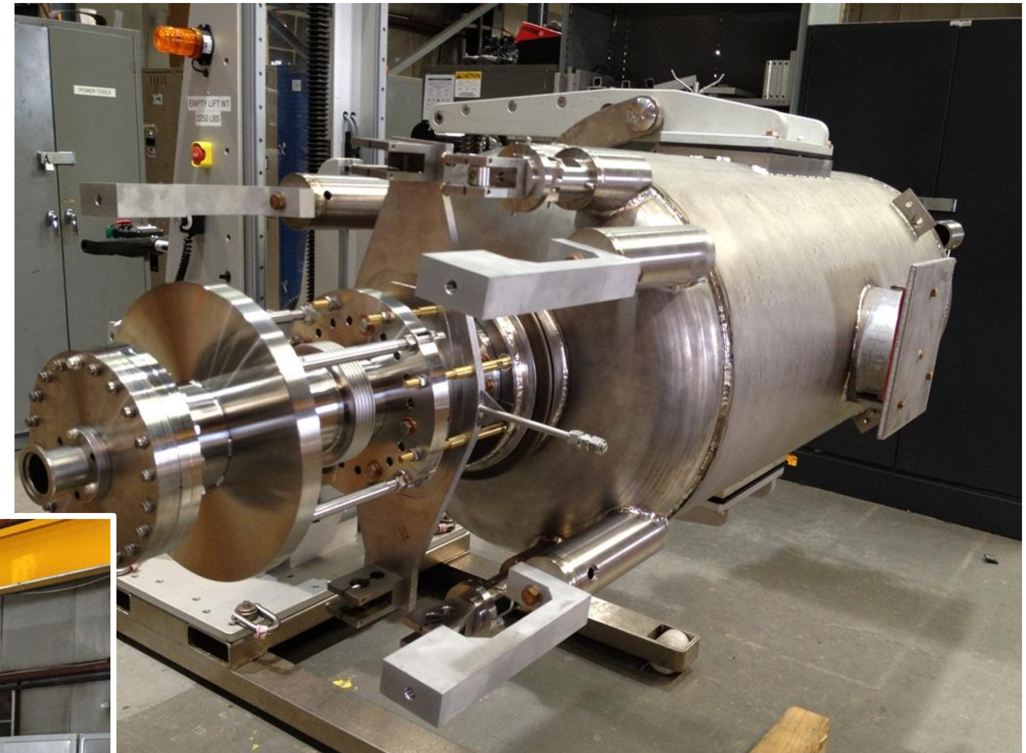
- λ/4 Ni resonator
- common to both beams
- beam driven
- 56 MHz, 2 MV

Calculation by M. Blaskiewicz

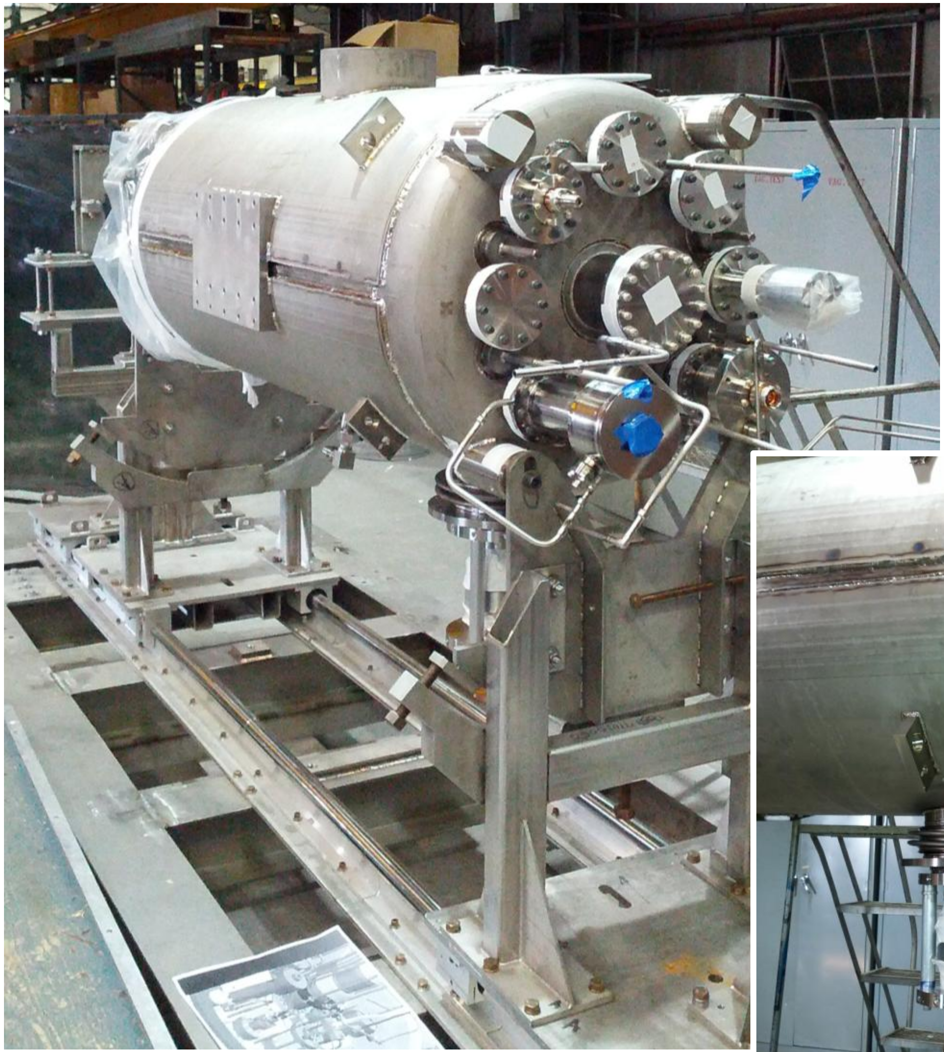
Mock-up cryomodule assembly in 905

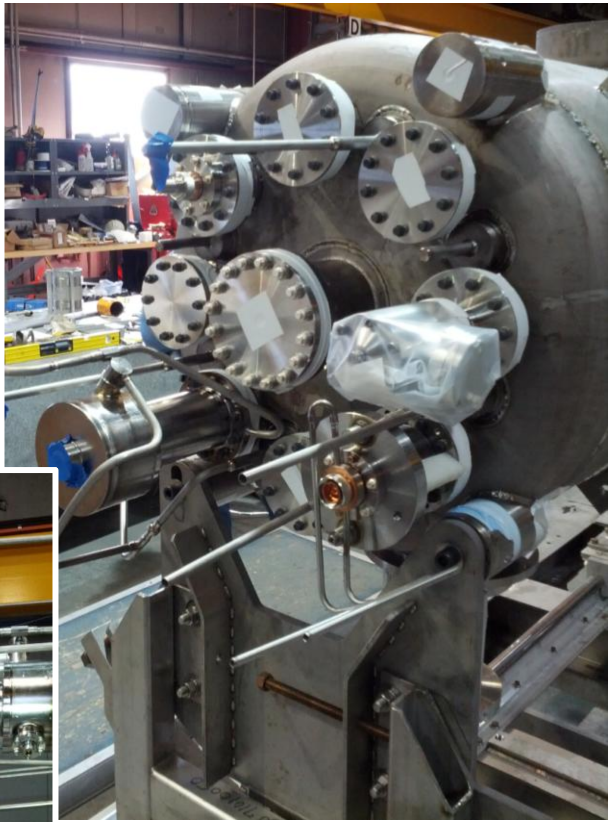




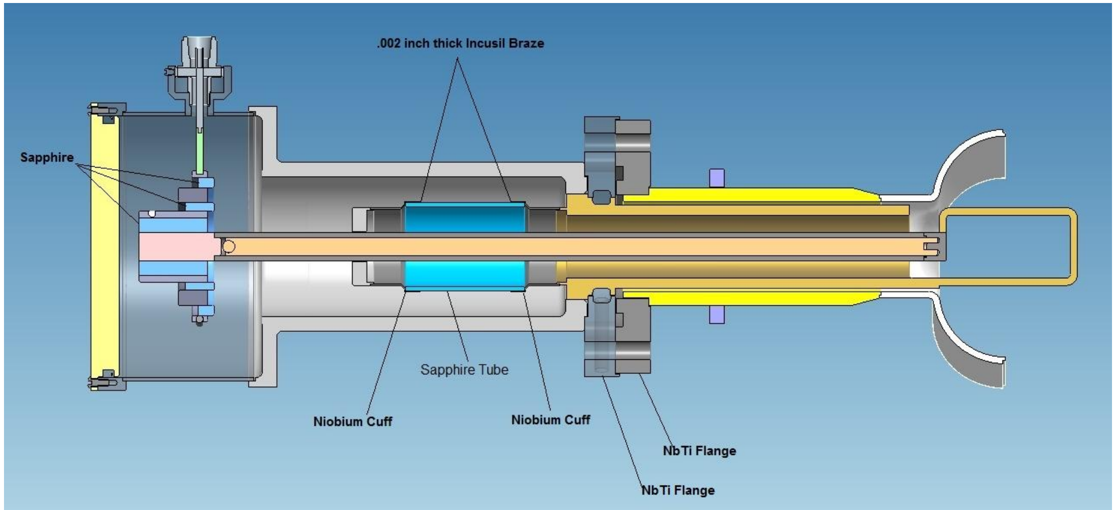


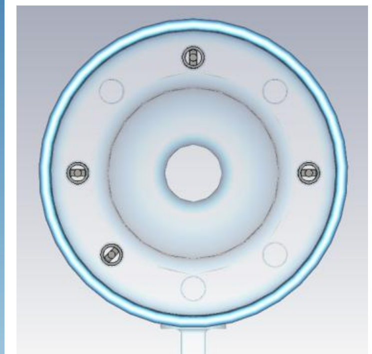
Cavity string assembly status

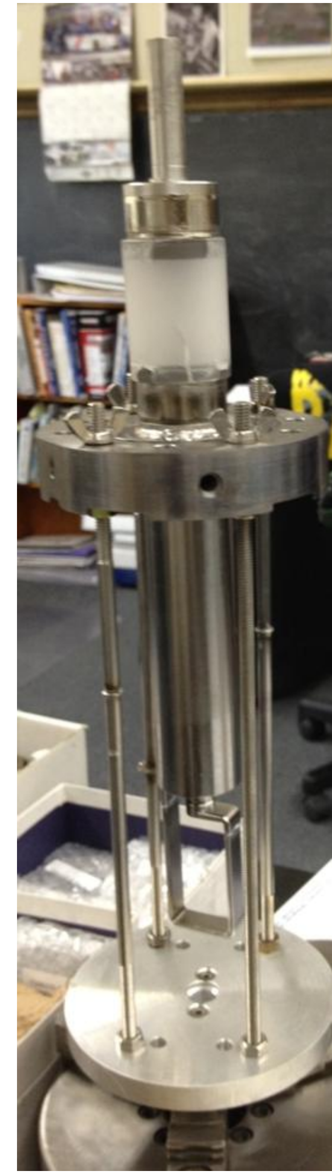




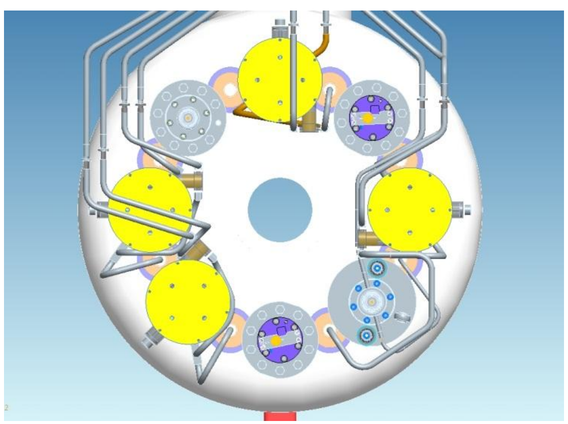
HOM coupler = coupling loop + filter

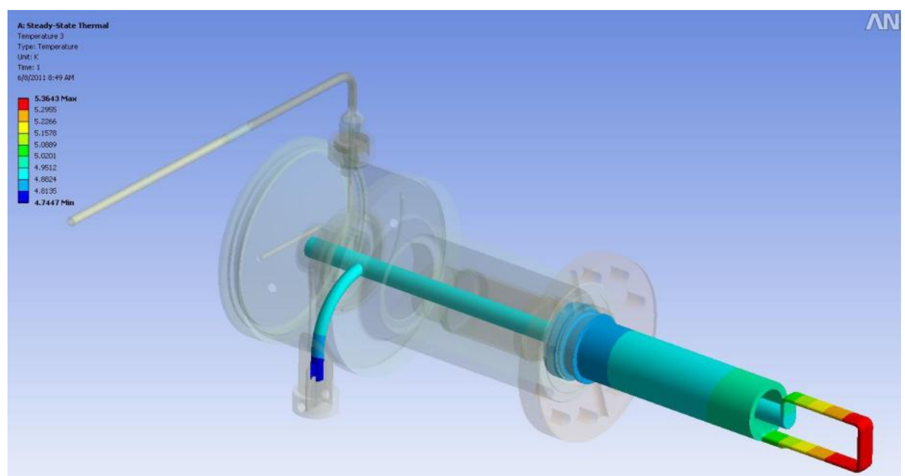






- Optimization of damping for all HOM modes up to 1 GHz, resulted in 4 HOM couplers.
- The couplers are inserted in an asymmetric configuration, which ensures that all modes are damped adequately.
- The NbTi flange will be cooled with helium.
- A high RRR copper rod inside the center conductor improves cooling of the loop. It is LHe-cooled.





56 MHz SRF in tunnel this morning (21 Jan 2014)

Commissioning plan

1. Warm testing.
2. Pre-Ops.
3. Cold testing/commissioning.

S. Belomestnykh

Warm testing

- Network Analyzer measurement of the Fundamental mode Damper (FD) coupling, Q_L ~ 300, when FD is fully inserted.
- The cavity quality factor at RT is $\approx 3.6\times10^3$.
- Network Analyzer measurements:
  - Cavity frequency – nominal 56.201 MHz at RT, 56.299 MHz when cold;
  - Coarse (stepper motor) tuner range, ± 25 kHz;
  - The cavity must be deformed if not within the range;
  - Fine (piezo) tuner range of 60 Hz;
  - Calibrate RF signals at RT.

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Pre-Ops

- MPS tested and configured properly.
- With RHIC at 40 K:
  - Can provide cold He gas for cavity cooling ;
  - Use FD to apply up to 1 kW RF for conditioning of multipacting – can reach about 17 kV.

S. Belomestnykh

Cold testing/commissioning

- RHIC at 4 K, about two days available during PS testing:
  - Finish MP conditioning;
  - Signal calibration, preliminary LLRF set up, verify LLRF protection functions;
  - Check cavity performance (Q *vs.* V);
  - Verify tuner operation;
  - Characterize microphonics;
  - Measure HOM spectrum.
- Store commissioning:
  - Can continue testing as far as the cavity frequency is offset from the beam frequency;
  - Observe/measure beam reaction on FD withdrawal, measure HOM spectrum excited by beam;
  - Verify tuner control and cavity voltage response;
  - Verify proper system response when beam is dumped;
  - Characterize AC coupled IQ loop performance at very low cavity voltage, set up gains, etc.

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